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DOCUMENT-IDENTIFIER: US 6555928 B1
TITLE: Power source control method for an electric vehicle

Brief Summary Text (5):
The present invention generally relates to power source control methods for electric vehicles. More particularly, the present invention relates to power source control methods for hybrid-driven vehicles having fuel cells and secondary batteries.

Brief Summary Text (7):
Electric vehicles, such as hybrid type electric vehicles, have been developed to reduce pollution output from vehicles. The hybrid vehicles generally feature an electric motor that propels the vehicle and two types of energy supply. One of the two types of energy supply can be a battery, such as a lead battery, that is capable of charging and that is capable of supplying electric power to the electric motor in quick response to load changes. The other of the two types of energy supply can be a fuel cell that is adapted to use easily-supplied fuel and that has low pollution output.

Brief Summary Text (8):
It should be mentioned that at least two types of fuel cells have been developed for these hybrid vehicles. One type of fuel cell uses hydrogen gas that is held in a hydrogen gas reservoir as fuel. The other type of fuel cell uses hydrogen gas that is generated in a reformer, such as by combusting methanol, methane or butane, which serves as the primary fuel.

Brief Summary Text (9):
In hybrid vehicles, especially in smaller vehicles such as motorized bicycles, load variation (i.e., the required load due to manipulation of an accelerator or due to changes in the external load resulting from changes in slope or other irregularities in the road) at the motor is substantial. Accordingly, quick response to fluctuations in load is desired.

Brief Summary Text (13):
In view of the foregoing, one aspect of the present invention provides a power source control method for a hybrid vehicle. The method preferably is capable of coping with load change by making proper use of two disparate power sources according to the operating characteristics of each. By accounting for the operating characteristics of the battery and the fuel cell, more stable operation of the vehicle results. In addition, the method advantageously reduces capacity shortening and deterioration of the battery.

Drawing Description Text (3):
FIG. 1 is a side elevation view of a hybrid vehicle featuring a control method having certain features, aspects and advantages of the present invention;

Drawing Description Text (4):
FIG. 2(A) is a side elevation view of another hybrid vehicle also featuring a control method having certain features, aspects and advantages of the present invention;

Drawing Description Text (9):
FIG. 6 is a block diagram of a control system of the hybrid vehicle arranged and configured in accordance with certain features, aspects and advantages of the

present invention;

Drawing Description Text (10):
FIGS. 7 and 8 are a flowchart of a control method for the hybrid vehicle, the method having certain features, aspects and advantages of the present invention;

Drawing Description Text (17):
FIG. 15 is a flow chart of a generation control subroutine that can be used to signal temporary stops of the hybrid vehicle and to trigger charging of the battery;

Detailed Description Text (2):
With reference now to FIGS. 1 and 2(A), two exemplary hybrid-driven vehicles are illustrated therein. The vehicles are indicated by the reference numeral 20. While the present invention will be described in the context of a motorized bicycle or scooter, the present invention has utility in a number of other applications. For instance, the present invention can find utility in applications as diverse as watercraft, three and four wheel vehicles and tracked vehicles. In addition, some features of the present invention may find utility in vehicles that are meant to fly or that are meant to be suspended upon a cushion of air. Of course, other applications will become apparent to those of ordinary skill in the relevant arts. In addition, while the illustrated arrangements will feature a fuel cell and a battery that form two power supply sources, it is anticipated that certain features, aspects and advantages of the present invention can be used in vehicles featuring two fuel cells, two batteries, a generator or a capacitor.

Detailed Description Text (14):
With reference now to FIG. 2(A), the exemplary hybrid vehicle 20 illustrated therein comprises a vehicle controller 34 and a battery unit 36, which is disposed generally under the seat 40. In the illustrated arrangement, the electric motor unit 30 is disposed generally below the vehicle controller 34. The fuel cell unit 38 is disposed forwardly of the illustrated electric motor unit 30 and is connected to a remote hydrogen supplying device 52. The device 52, in the illustrated arrangement, is mounted rearward of the seat 40 on a rack 50. The hydrogen supplying device 52 supplies hydrogen to the fuel cell unit 38 for power generation.

Detailed Description Text (55):
In the illustrated arrangement, the electric motor unit 30 comprises the motor driver 80, the encoder 32, the sensors 90 and the electric motor 82 (FIG. 3). In the presently preferred arrangement, each of these components are integrated together as a single module. Such an electric motor unit 30 can be removably mounted to the vehicle 20 as a unit. Therefore, the two-way communication line 220 and the current lines 226, 228, 232, 234 each can be connected between the electric motor unit 30 and the vehicle controller 34 using electrical couplers (not shown), such as quick connectors, clips and the like. In the following descriptions, similar types of connectors or couplers can be used where indicated.

Detailed Description Text (58):
The fuel cell unit 38 preferably is an integrated unit as well. As such, the fuel cell unit 38 comprises a fuel cell controller 102, the sensors 120, 122, 124 (FIG. 3), the relay 106 and the fuel cell 100. More preferably, the reformer 62, the shift converter 134, the selective oxidation reactor 136 and the associated lines and valves are integrated into a single module. Such a fuel cell unit 38 can be removably mounted on the vehicle 20 and such a fuel cell unit 38 preferably comprises electrical couplers (not shown), such as quick connectors, that connect the two-way communication line 224 and the current lines 226, 228 to the fuel cell controller 102 of the fuel cell unit 38.

CLAIMS:

27. A power source control method for a hybrid electric vehicle, the vehicle having a fuel cell and a battery, the fuel cell and the battery each being electrically connected to an electric motor, the electric motor powering the vehicle, the method comprising sensing a varying load on the electric motor, dividing the varying load into a substantially constant base load portion and a varying supplemental load

portion, the base load portion being supplied to said electric motor from said fuel cell and the supplemental load portion being supplied to said electric motor from said battery under at least some operating conditions.